

REMARKS

Claims 1-15 are pending. All claims are under examination. No claim is withdrawn.

Information Disclosure Statement

The acknowledgement by the Examiner in the first paragraph on page 2 of the last Office Action is appreciated. The Examiner is respectfully requested to do the same with respect to the second Information Disclosure Statement filed on or about September 28, 2005.

Issues under 35 USC 112

The rejection of claims 1-15 under the second paragraph of 35 USC 112 is traversed but has been rendered moot by the present amendments.

The Examiner is thanked for the helpful suggestions all of which have been followed in substance.

As presently amended claims 5 and 10-15 have had their dependency changed such that they clearly comply with 35 CFR 1.75(c). Examination on the merits of these claims is respectfully requested.

Issues under 35 USC 102

The rejection, beginning in the last paragraph on page 2 of the last Office Action of claims 1-15 under 35 USC 102(b) as anticipated by US Patent 5,525,671 (Ebato) is traversed but has been rendered moot by the present amendments.

Ebato discloses a process for continuously producing a linear lactide copolymer having a weight-average molecular weight of from 20,000 to 40,000 using a continuous reaction apparatus

composed of three or more stirred flow reactors connected in series, which comprises the steps of:

continuously feeding from 50 to 98 parts by weight of a lactide and from 2 to 50 parts by weight of a polymer having a hydroxyl group in a molten state or as dissolved in a solvent to the first reaction of said continuous reaction apparatus; and

transferring the reaction mixture from said first reactor to the following reactors successively while maintaining the reaction pressure and the reaction temperature in every reactor in the range from 1 to 5 atm. and of from 140° to 210°C, respectively, to conduct ring opening copolymerization (claim 1).

Ebato also discloses that the rate of polymerization of the lactide in the first reactor is from 30 to 80% and that the reaction mixture in that reactor has a viscosity of not higher than 2000 poise (claim 2).

The Ebato polymer having a hydroxyl group may be a hydroxyl-terminated polyester having a melting point or a softening point of not higher than 180°C (claim 3).

Regarding the static mixer, Ebato discloses that the reaction mixture from the last stirred flow reactor is subjected to further ring opening copolymerization in a reactor equipped with a static mixer (claim 7).

Ebato found that a reaction between a lactide and a polymer having a hydroxyl group at a specific ratio in three or more reactors develops possibilities of using a variety of polymers as reactants and produces a variety of lactide copolymers from soft to rigid with a high weight-average molecular weight ranging from 20,000 to 400,000 with excellent transparency, at a reaction rate equal to or even higher productivity (col. 2, line 52-54).

Regarding the reactor, Ebato discloses as follows:

In a continuous reaction by use of a plurality of reactors, while the reaction mixture in the reactor used in the initial reaction stage can be stirred satisfactorily irrespective of the shape of the stirring blade because of its low viscosity, a turbine impeller blade, a Phaudler type impeller blade, a helical ribbon blade or a combination thereof is recommended for effectively causing a flow in the vertical direction. Anchor type paddles are also preferred for their capability of uniformly agitating the whole reaction system.

The reaction mixture in the reactor used in the final reaction stage has a high viscosity so that the shape of the stirring blade largely influences the stirring effect. The stirring effect tends to become insufficient particularly in the vicinity of the reactor wall. It is therefore preferable to use a stirring blade capable of uniformly agitating the whole reaction system, such as a turbine impeller blade, a helical ribbon blade, and an anchor paddle, for effectively scraping the reaction mixture from the inner wall of the reactor. (Column 4, lines 18-34).

Regarding the static mixer, Ebato also discloses as follows:

Since the product withdrawn from the last reactor still contains slight amounts of unreacted starting materials or intermediate products, heating by a vertical shell-and-tube heat exchanger or a static mixer equipped with a heat exchanger is preferred also for accomplishment of the reaction of such unreacted materials or intermediate products. In particular, such a highly viscous reaction zone having a resin viscosity exceeding 10,000 poise as developed in the process of the present invention encounters with vigorous heat generation due to shearing force in stirring as well as polymerization heat. If dynamic stirring is employed in such a highly viscous zone, local heat generation would be vigorous around the agitator. From this viewpoint, use of a static mixer which imposes small shearing stress and yet exerts a stirring effect uniformly is especially preferred. (Column 7, line 60 to column 8, line 8).

Regarding the effects of the invention, Ebato also discloses as follows.

. . . the present invention eliminates the production problems associated with conventional continuous production methods for lactide copolymers, i.e., high viscosity of the reaction system, thermal decomposition of the polymer produced, coloration of the polymer produced, and the like. The present invention thus provides a process for continuously and effectively producing a degradable lactide copolymer which can be endowed with broader range properties than conventional lactide copolymers and are therefore useful in wider fields as packaging films or sheets, injection moldings, laminates, and industrial moldings (Column 18, lines 36-47)”

(3) Comparison of the present invention and the cited reference

(A) Structure of the invention

(i) Claim 1

Ebato never discloses nor suggests a combination of the specific agitating mixer with a static mixer. Although Ebato discloses some blades or paddles of a dynamic mixer, such as a turbine impeller blade, a helical ribbon blade, and anchor type paddles, these are different from the blades or paddles of the agitating mixer in the present invention. Thus, the subject matter of the claim 1 of the present invention is clearly distinct and is not obvious to the skilled artisan in view of Ebata.

(ii) Claim 6

Ebato fails to disclose or suggest not only a mixing unit consisting essentially of static mixers but also a combination of a plurality of static mixers different in type. Specifically, Ebato's invention essentially requires a dynamic mixer. Thus, the subject matter of claim 6 of the present invention is clearly different and could never be predicted from Ebato.

(B) Advantages

The present invention shows unexpected results. That is, since Ebata uses essentially three or more reactors having a dynamic mixer and if necessary a reactor equipped with a static mixer. Furthermore the viscosity of the polymer considerably increases in the subsequent dynamic mixing reactor(s). Thus, efficient mixing would not be achieved and the quality of the resultant polymer product is not stable.

Contrarily, according to the present invention, use of a reactor having specific mixers enables good blending of reaction components even with high viscosity; an efficient removal of the polymerization heat and stable operation with a small pressure loss. Moreover, the present invention can provide a high-molecular weight polymer with high quality and high productivity without decomposition and coloring. Such unexpected results and advantages are clearly supported by the present specification including the Examples and would never be predicted by Ebato.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone David R. Murphy, Registration No. 22,751, at (703) 205-8000, in the Washington, D.C. area.

Prompt and favorable consideration of this Amendment is respectfully requested.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

By  #32868

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